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SPACE SHUTTLE PROGRAM STATUS BRIEFING

SPEAKER:

WAYNE HALE, Manager, Space Shuttle Program

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Johnson Space Center

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1 P R O C E E D I N G S

2 MODERATOR: Good afternoon, everybody. Welcome
3 to the Johnson Space Center and this update on the progress
4 toward launch of Discovery on the STS-121 mission.

5 Joining us today is the program manager for the
6 Space Shuttle program. That is Wayne Hale. He will give
7 you all the details and update on the preparations ongoing,
8 and then we will take questions from NASA centers.

9 We also have a phone bridge, and we will take as
10 many calls as we can, questions from that, as we have time
11 allotted. We do have to finish this briefing by the top of
12 the hour at the latest. So we may not get to everybody,
13 but I can assure you that you will get the information.

14 And with that, I will turn it over to Wayne.

15 MR. HALE: Thanks, Kyle.

16 Good afternoon, everybody. Thank you for being
17 here.

18 We had an interesting set of names over the last
19 couple of days and have made some decisions just today,
20 about 2:00 this afternoon, that we thought would be good to
21 share with you.

22 We have been watching a problem, as you know,

1 with our low-level sensors, what we call our "engine
2 cut-off sensors," go by the acronym ECO sensors, in the
3 external tank.

4 If you will recall from last summer, we had a
5 couple of problems which caused us a great deal of wonder
6 about what was going on with the system that tells you when
7 you are about to run out of fuel and the liquid hydrogen
8 tank, the external tank.

9 We kicked off a large investigation after the
10 events last summer. The NASA Engineering and Safety Center
11 participated very heavily in this investigation, as did the
12 external tank project at Marshall Space Flight Center
13 Engineering, and during the course of this investigation
14 over the last several months, they found that there may be
15 a problem in manufacturing some of these sensors. That
16 problem is in the way the wires are attached to these
17 low-level sensors.

18 And you are going to pardon me because I am going
19 to go low down into the technical here, and we will come
20 back at the higher level in just a minute.

21 There is a place that the wires attach to the
22 sensor. It is called a swage fitting. That swage fitting

1 in some sensors that have been removed sometime back in the
2 history of the program has been noted to be a little loose,
3 and that has caused intermittent readings of varying
4 resistance in the sensor which, of course, is how the
5 sensor tells you whether it is reading a dry or a wet
6 signal.

7 Last year, when we prepared to launch STS-114, we
8 had a high degree of confidence that the sensors would only
9 fail, if they were to fail, in the wet reading condition.
10 After a lot of work, there is now some body of evidence
11 that would indicate it is possible -- [audio break].

12 [Audio break: 15 seconds.]

13 MR. HALE: [In progress] -- moderately hard
14 decisions and only bring me the very few decisions that
15 remain. So we had, as you might expect, quite an
16 interesting debate, pros and cons, looked at every possible
17 way around this and finally concluded that it was far
18 smarter for us to be conservative and take the safe route
19 and replace the sensors that are in the tank.

20 That will take us about 3 weeks of work, and
21 that, of course, will move us out of the May launch window
22 for STS-121. So today, we are proposing that

1 no-earlier-than launch date, the earliest possible launch
2 date, would be July 1st which is based on lighting.

3 We, in fact, will be ready we think with the
4 vehicle before July 1st, but we are dedicated to launching
5 in the daylight so we can watch what happens to the
6 internal tank and the rest of the flight vehicle during the
7 daylight for at least two more flights, STS-121 and the
8 subsequent STS-115. So we are aiming now for July the 1st.

9 The team has been working very hard. We have
10 worked folks, particularly those folks at the Michoud
11 Assembly Facility that had been preparing the tank very
12 diligently and very hard to get to potential to launch in
13 May. We wish it had have worked out differently, but it
14 is, of course, first and foremost that we fly safely. We
15 want to have a good attempt when we fly in July or whatever
16 date it is, and so it was prudent to change the sensors out
17 and take the time to do this work.

18 We did discover this reading shortly before the
19 tank was shipped from Michoud, and we did have a discussion
20 about whether it would be advisable to replace those
21 sensors at the factory. Due to the fact that those sensors
22 are most easily changed from the tanks in the vertical

1 position, it was generally agreed at that time that if
2 change-out were required, it would be better to do that at
3 the Kennedy Space Center where the tank is in the vertical
4 position in its check-out cell in the vehicle assembly
5 building rather than to do that at Michoud. Of course, the
6 engineering work was still in debate for sometime until we
7 made the decision today.

8 The folks that will be doing the work are workers
9 from the factory, Lockheed-Martin's factory at Michoud,
10 coming from New Orleans. They will be traveling to the
11 Kennedy Space Center where they will be entering the tank
12 from the bottom. There is a large manhole cover on the
13 bottom of the tank. They will remove the foam insulation,
14 remove a number of bolts to take the metal parts apart, and
15 then they can enter.

16 There are plenty of work platforms in the area.
17 The access is quite good, going to the tank, removing the
18 sensors, and replacing them with new and, I would say, much
19 better screen sensors, so that we will not have the
20 potential of having this same problem to the best of our
21 ability on new sensors, newly manufactured sensors, and
22 then backing out of the tank, closing it back up,

1 reapplying the insulation to the bottom of the tank.

2 All standard processes using standard tools will
3 be done by the people that normally do this work at the
4 factory at Michoud.

5 We hope to take the four sensors that we will
6 take out of the external tank and put them in extensive
7 tests. We want to see if the one sensor that has got the
8 slightly elevated resistance reading really has this
9 problem that the engineering tests say could potentially
10 have, and then, of course, we will look at the other three
11 sensors which were manufactured about the same time in the
12 same facility.

13 We have a number of these sensors and tanks that
14 are still slated to fly. The sensor in question was made
15 10 years ago in 1996 and passed all its acceptance tests
16 and, in fact, appears to have shifted in its reading not
17 this time when it was transported to the Kennedy Space
18 Center, but when it was transferred last summer before
19 STS-114 to the Kennedy Space Center.

20 Let's see. What else can I say?

21 We are all very optimistic that we will be able
22 to wrap up the rest of our work. You know we have a number

1 of other challenges ahead of us that we are going to be
2 tight on the schedule to get done to support a May window.

3 This additional 6 weeks that we will now have should
4 provide us plenty of time to wrap up our work on the
5 aerodynamics looking at the airflow over the tank after
6 removing a lot of foam in the protuberance airload ramp
7 area, and I think we will be in good shape to look forward
8 to a launch about the 1st of July. The folks are off
9 evaluating at my direction this afternoon.

10 Subsequent launches, I really don't have anything
11 to say about that other than I remain optimistic we will
12 still be able to get three missions in this year, but I
13 don't have the details on where we will fly the next two
14 missions, later in the fall I'm sure, and we will have
15 those data for you in another week or so, I think.

16 So, with that, I guess I am ready for questions.

17 MODERATOR: Okay. Let's limit it to one question
18 apiece, please, and I will get to as many people as I can.

19 And I'm not choked up about everything you said,
20 by the way.

21 We'll start with Craig.

22 QUESTIONER: Craig Cavault, Aviation Week.

1 Wayne, what is the increased process rigor,
2 inspection rigor that will be put in place, and were there
3 any pre-Columbia mission sensors that flew that had this,
4 even the subtle characteristic that documentation has
5 turned up?

6 MR. HALE: Indeed, we looked at the entire family
7 of sensors that were made in that calendar year. There
8 was, we think, some concerns with the device that makes
9 this electrical swage connection, that have subsequently
10 been corrected.

11 Out of the about-400 sensors that were
12 manufactured in that calendar year, there were 10 or 11
13 that were removed during the build-up, after they had been
14 accepted, after the sensors themselves had been accepted,
15 but during the build-up of the tanks that were removed,
16 some of those did show a loose swage connection.

17 We also flew at least two sensors in that group
18 of family of course, few them a couple of years later in
19 the 1999 time frame, that did, in fact, show small changes
20 in resistance that operated perfectly normally.

21 So what we have here is an indicator. It is not
22 a guarantee. It is entirely possible we could pull the

1 sensor out and it will be perfectly fine, but we think we
2 have enough of an indicator that says we ought to go take a
3 really hard look at this and make sure that we have got a
4 really good set of cut-off sensors because, after all that
5 is a critical function, and we want to be safe when we fly.

6 MODERATOR: Go ahead, Guy.

7 QUESTIONER: Guy Gugliotta, The Washington Post.

8 Is this a design flaw, Wayne, or is this
9 something that happens to particular sensors in a
10 particular lot?

11 MR. HALE: I would say that it is hard to
12 characterize. I would say that this particular way to make
13 electrical connections is a difficult operation, and so
14 there is some talk of potentially changing the design.

15 I would also tell you that these sensors, or
16 sensors that are manufactured in the same way by the same
17 folks, are used in a variety of programs. They were used
18 on the Saturn launch vehicles. They were used in the
19 Delta, some of the Delta launch vehicles, some of the other
20 expendable rockets. So this technology is not a really new
21 technology. It has been robust over the years, but again,
22 it shows the level to which we take safety in this program

1 to make sure that we are going to fly with a good set of
2 sensors.

3 MODERATOR: Do you have a question, Laura?

4 QUESTIONER: Yeah. Laura Rotely [ph] from KTLK
5 TV.

6 Wayne, could you explain why the decision to push
7 back the May launch date -- it is such a painstaking
8 decision -- and why that is so hard for you guys?

9 MR. HALE: Well, again, the decision that we made
10 today was not based on schedule. Let me make that very
11 clear.

12 The decision that was difficult for us was
13 because the evidence is not black and white. There are
14 indications in some engineering tests that indicate we have
15 got a concern on the one hand versus the fact that you have
16 to go into the tank. You have to open it up, take the
17 pressure seals apart, take the insulation off, go inside of
18 that tank, change electrical connections, and then back out
19 and button everything up. There are certain risks involved
20 that you could damage the tank and so on and so forth.

21 So, when you look at it as a risk, what do we
22 know about the sensors and what is the risk there versus

1 the risk, what do we know about the work to change the
2 sensors out and what is the risk there, and we made the
3 decision based on the relative risk, quite frankly, of
4 those two operations, and then the schedule fell out where
5 it was. So this was not a discussion about schedule. This
6 was a discussion about safety, and we came down on the side
7 of doing what is right to make sure we have a pristine tank
8 and we will be ready to go fly safely when that tank is
9 ready to go fly, as we do with all our equipment.

10 MODERATOR: Irene, and then Mark.

11 QUESTIONER: Hi. Irene Klotz with Reuters.

12 Wayne, where do things stand on the wind tunnel
13 tests with the foam? Have you learned anything yet?

14 And also, do you know the name of that
15 manufacturer of the ECO sensors?

16 MR. HALE: You know, I should have gotten the
17 name of the manufacturer before I came over here.

18 We had a discussion last year, and there's a
19 couple of companies that have the same or similar name, and
20 I don't want to put the wrong name out. So let us make
21 sure we get the right name.

22 I want to also hasten to add that this is not a

1 shortcoming on the manufacturer's part. This is a
2 precision part, and in any normal kind of industry, the
3 failure rate would clearly be well within what consumer
4 electronics or anything would allow. This is a very
5 reliable part, and we believe that, if anything, the
6 manufacturer has improved the process over the years, and
7 they are making them better now than they were in years
8 before. So don't take the long message from this
9 discussion.

10 MODERATOR: Wind tunnel.

11 MR. HALE: Wind tunnel tests. Thanks.

12 Changing gears a little bit, you know, one of the
13 things that we have done to improve safety with the
14 external tank is to remove about 40 pounds of foam off the
15 outside in the protuberance airload ramp area. Those wind
16 deflectors on the outside of the tank protected the cable
17 tray and pressurization line that runs up the outside of
18 the tank.

19 We have started the wind tunnel tests. We have
20 got wind tunnel tests running specifically at Ames Research
21 Center and the Glenn Research Center. The Glenn Research
22 Center wind tunnel has a 50-percent-scale model of a small

1 portion of the tank, and the Ames Research Center has got a
2 3-percent-scale model of the entire Shuttle launch vehicle,
3 and both of those tests are in progress.

4 The Ames tunnel went supersonic for us just the
5 other day. The results are coming in, and the engineers
6 are poring over them. I would tell you there is one thing
7 certain about wind tunnel tests is that the data have to be
8 interpreted.

9 The early results, I don't have a very good
10 handle on, but they are proceeding, and the engineers are
11 looking at the data, and I expect to get a report shortly
12 on some of the preliminary data, but the good news is we
13 got the models fabricated. We are in the wind tunnels.
14 The wind tunnels are operating, and we are gathering the
15 data we need to make a good determination of the safety of
16 the new design.

17 MODERATOR: Mark.

18 QUESTIONER: Mark Carreau from the Houston
19 Chronicle.

20 I have a question about how the sensors work in
21 concert with the flight controls. If you could just sort
22 of explain the main mechanism that shuts off the main

1 engines is not the sensors, as I remember, it is more of a
2 backup mode, or could you just sort of explain the critical
3 nature of this hardware?

4 MR. HALE: Well, just like in your car, you don't
5 want to run it until it runs out of gas. That's not a good
6 thing. So you would like to get where you want to go
7 before the tank is completely empty.

8 So the normal planning for a mission allows us to
9 achieve the right orbital conditions -- altitude, speed,
10 direction of travel -- without running out of propellant.
11 In fact, we load extra fuel on board to make sure that even
12 if we have small variations in the performance of the
13 vehicle during launch, a small reserve is there to make
14 sure that we get to that point in the sky, without running
15 out of gas. As a result, when we jettison the tank, we
16 always throw away some amount of liquid hydrogen and liquid
17 oxygen which comes in with the tank and is disposed of in
18 the Indian or Pacific Ocean.

19 The sensors are there in case we have some kind
20 of performance problem, which we have had twice in the
21 history of the program. The first kind of thing that can
22 happen to you is if you have an inadvertent or a premature

1 shutdown of one of the main engines, then the other two
2 engines have to work longer and use more gas to get where
3 you want to go.

4 We had that occur to us way back before -- well,
5 it was in 1985 -- STS-51F. I very clearly remember that
6 flight had some problems with the different -- totally
7 different kind of set of sensors that monitors the
8 performance of the engines and erroneously shut the engines
9 down. It shut one of the engines down based on some
10 erroneous sensor data. The engine was perfectly fine.

11 We have since gone to a great deal of effort to
12 improve those sensors, by the way, but because of that, we
13 did run out of gas before we reached the orbital altitude
14 that we wanted, and the sensors were there to shut the
15 engines down safely.

16 The second flight that we had an occurrence on
17 was STS-93, the delivery of the Chandra Space Telescope to
18 orbit, back in 1999. If you will recall, we had a problem
19 where we had a little hydrogen leak at the cooling tubes of
20 the engine, plus a couple of other things that happened,
21 the short that caused us to disqualify half-an-engine
22 controller. So we had some shifts in performance and came

1 up just a little bit short, just a fraction of a second
2 short of where we wanted to be in terms of engine burn
3 time.

4 In both cases, the sensors, through the on-board
5 computers, correctly told us that the tank was dry, we were
6 out of fuel, and we should shut the engines down. You like
7 to shut the engines down with just a little bit of gas left
8 in the lines to make sure that those pumps that pump the
9 fuel and that brought the hydrogen and the oxygen into the
10 engines don't cavitate as they spend down. That is not
11 good for the engines, and it can lead to a number of
12 problems.

13 So we have in place these sensors on both the
14 fuel side and the oxygen side to let us know before the
15 engines actually don't have any gas left -- the tank may be
16 empty, but while there is still gas literally in the line
17 -- to shut the engines down so that it is a safe shutdown.

18 That is what they are there for.

19 And there is quite an elaborate logic scheme to
20 make sure you do it at the right time and not at the wrong
21 time, and a quad-redundant, there is four of these sensors,
22 they vote to get that indication.

1 MODERATOR: Okay. Let's go to the Kennedy Space
2 Center in Florida for questions there.

3 QUESTIONER: This is Kevin Oliver from WOTV in
4 Orlando.

5 Wayne, could you just run through some of the
6 risks you have run by going into the tank while it is here
7 at the space center?

8 MR. HALE: You know, the principal risk that we
9 run by going into the tank is the risk of hardware damage
10 to the tank that would make a more different kind of
11 repair, say on the seal around the manhole cover, something
12 like that, that would cause a schedule risk.

13 Whenever you put a person inside the tank, they
14 are in a confined space, and there is clearly a hazard
15 there, and they have got to be provided with breathing air
16 and closely monitored. Folks will be going up on
17 scaffolding. That is also a personnel hazard. It is
18 something they do in the normal course of business both at
19 the Kennedy Space Center and at the Michoud Assembly
20 Facility, but at any time you do that kind of work, you
21 take certain kinds of risk.

22 The kind of risk that I want to tell you we are

1 not taking is a flight risk because we think that anything
2 that might not turn out in this repair or wouldn't be
3 detectible by us before we close out the tank. So that
4 when we go to fly, it will be a good tank.

5 So, really, what we are looking at are two sorts
6 of risks, damage to the hardware that could take us longer
7 to fix than we anticipate -- we think that's very low --
8 and then the personnel hazards, as I described, which we
9 have a large amount of safety processes in place to keep
10 from hurting anybody.

11 MODERATOR: Todd.

12 QUESTIONER: Todd Halverson of Florida Today, for
13 Wayne obviously.

14 Are the sensors on the 119 tank from the same
15 manufacturing lot as the sensors that were on the ET-120,
16 and is there any reason you guys didn't swap out the
17 sensors in ET-119 after the trouble cropped up on STS-114,
18 or were new sensors not available? I am trying to get a
19 sense of your decision-making process on this.

20 MR. HALE: Well, the sensors are not made in
21 lots. So we are looking at calendar years at this point of
22 when the sensors were manufactured.

1 Again, there are some tooling things that were
2 going on in the 1995-6 time frame that have put a little
3 shadow on the sensors that were manufactured then. So the
4 sensors that are in ET-120 that you will recall we tanked
5 twice and sent back to the factory as well as the sensors
6 in ET-121 that we used for the mission last July and the
7 sensors that are in this tank that we now have at the
8 Kennedy Space Center that we are planning to use for the
9 next flight, as well as other tanks, we have those sensors,
10 and they're common in these tanks.

11 What we have learned in the year -- well, 8
12 months since we flew is a better understanding of how these
13 sensors work, and the indication that a small shift in
14 resistance could be indicating that we might have a problem
15 with the sensor.

16 We don't have any of those shifts in resistance
17 indicated on the next tank that we've got. We don't have
18 any shifts in resistance indicated on three of the four
19 sensors in the current tank.

20 Then, in fact, I should tell you that on ET-120,
21 where we did have some erroneous reading from the system --
22 now, remember, it's not just the sensor. There's wires and

1 connectors, and then you get to the orbiter side, there's
2 more wires and connectors, and finally, you get to this
3 electronics box that tries to make sense out of the
4 resistance reading. We still do not have a good and
5 complete resolution to what caused the problem that we saw
6 with ET-120.

7 Now, I will tell you that we are in planning to
8 go in the ET-120, which is currently back at the Michoud
9 Assembly Facility, and pull out those sensors and look at
10 them. Clearly, something happened during our tanking test
11 with that tank that caused the sensor on the first tanking
12 test to read erroneously, and when I say sensor, I should
13 say sensor system. Again, as we don't know where in that
14 chain the erroneous reading occurred, we want to pull those
15 sensors out of the tank and look at them very closely.

16 Right now, they don't show any resistance changes
17 from when they were manufactured. So, again, we have a
18 suspicion and some body of evidence, and we would like to
19 get clear of that, but we are going to be removing those
20 sensors and looking at them over the next couple of weeks
21 as well.

22 MODERATOR: Okay. We are done with KSC.

1 Now we have the phone bridge, and this is similar
2 to a normal media telecon that we would do if we weren't on
3 NASA TV. So star-6 mutes, and star-6 un-mutes your phone.

4 We will go through as quickly as we can. I doubt we will
5 get to everybody, but we will start with Warren Leary.

6 Hopefully, Warren, you are on the line.

7 QUESTIONER: Warren Leary with the New York
8 Times.

9 Wayne, other than waiting for the wind tunnel
10 results on the foam, what does the extra time give you in
11 terms of other preparations for this flight, what you will
12 be able to do, let's say, at a more leisurely pace than you
13 would have going from a --

14 MR. HALE: Well, there are clearly other
15 engineering topics under investigation. They will be in
16 their investigation. Every time we go fly, this will give
17 us a chance to get a little further down the road on some
18 of those topics.

19 We have been interested in changing out some of
20 the outer window panes on the orbiters. This is going to
21 give us a chance to do some of that work.

22 As you know, we have been removing and replacing

1 gap fillers between the tiles on the orbiter. This will
2 allow us time to do even more of those if we determine that
3 is necessary.

4 There are any number of aging aircraft issues
5 that we have tests in progress that we think are going to
6 turn out in our favor, but we will certainly keep an eye on
7 any of them.

8 There is always a challenge in the space business
9 trying to keep up with all of the technical things that you
10 would like to do. There are proposed improvements in the
11 system, we will continue to look at. Six weeks is not a
12 long time to make a huge number of improvements, but if one
13 of those comes along that we can make, we certainly will.

14 MODERATOR: Dan Billow.

15 [No response.]

16 MODERATOR: How about Bill Harwood?

17 [No response.]

18 MODERATOR: Let's see. Tariq Malik, are you on?

19 QUESTIONER: Yes, I'm here. Thank you. Tariq
20 Malik, Space.com and Spacenews.

21 Wayne, I was just, you know, curious. You
22 mentioned that you have plenty of time available towards

1 having to get these other things out of the way and have
2 the orbiter ready to fly in July. I guess, is there a
3 break then in that time? I mean, will you have an extra
4 week kind of in that schedule to get stuff finished? Is
5 there even 2 weeks, I guess, in that 6-week period? What
6 is your projection there?

7 MR. HALE: Well, you know, we were racing very
8 hard to get to the mid-May launch period, and this extra 6
9 weeks, obviously the folks working on the tank will be
10 continuing to work, but I would expect it would allow us to
11 slacken the pace in other areas, perhaps not work overtime
12 that we were intending to work, perhaps allow us to take
13 some weekend days off that we were planning to work. All
14 of that is under assessment at the Kennedy Space Center.

15 MODERATOR: Let's see. Chad Murray, are you on
16 the line?

17 [No response.]

18 MODERATOR: How about Ned Potter?

19 [No response.]

20 MODERATOR: How about Mike Cabbage?

21 QUESTIONER: I'm here.

22 MODERATOR: Okay.

1 QUESTIONER: Wayne, I wanted to follow up on one
2 of your earlier answers. Do you see no relationship
3 between the problem that you found here with the
4 manufacturing issue and the anomalies that happened last
5 year during the tanking test and the countdown, or is there
6 some way they could be interrelated?

7 There is a second part be-real-quick question.
8 What is your latest on what the July window is, from when
9 to when?

10 MODERATOR: Well, let's see. The July window
11 extends from July the 1st through July the 19th. There may
12 be a day or so on either end of that, depending on the
13 orbital altitude of the Space Station and how that affects
14 lighting, but I think today's calculation is July 1st
15 through the 19th.

16 You know, the jury is still out. I would not
17 tell you we have conclusively proven that this swage
18 connector issue is what caused the problems last summer.
19 There are a number of potential areas that we identified in
20 the fault tree that could still have caused those problems.

21 We have been planning a full systems test where
22 we take an end-to-end system and put it on a laboratory

1 bench -- that is everything, the wires, the connectors, the
2 point sensor box, the sensors themselves -- and subject it
3 to some laboratory testing. We may yet do that.

4 I think a lot is going to depend on what we see
5 on these sensors that we pull out of the tank that is in
6 Florida now and the tank that we had the problem on last
7 spring and have back at the manufacturer.

8 We have been concentrating, I might add, on that
9 ET-120 tank that is back at Michoud on the foam
10 applications, and so we have put a lower priority on the
11 engine cut-off sensor, but it has been on the list of
12 things to do. As I said, we always can come up with more
13 tests to run, and we will get to those in due time.

14 MODERATOR: How about Mike Snyder with the
15 Associated Press?

16 QUESTIONER: Hi, Wayne.

17 How does this decision affect what will happen to
18 Discovery's robotic arm? Will it be replaced or repaired?

19 And then also if you could just talk about the
20 schedule for the rest of the year. I guess the next two
21 opportunities are still going to be August and November?

22 MR. HALE: Well, let's talk about the arm a

1 little bit. You know, we had an unfortunate incident that
2 caused some damage to the robot arm that is on Discovery.
3 We have, I think, already pulled that arm off. If not, it
4 will be in the next couple of days, but I believe it is off
5 already and back in the shop there in the VAB to be looked
6 at.

7 We determined that the best way to fix that arm
8 is to take the graphite epoxy boom section out and replace
9 it with a new one. That process takes a couple to 3 weeks.

10 We have the arm that was taken off Endeavour which is in
11 depot-level maintenance that we can put back on.

12 The interesting thing about the arm that was
13 damaged was we had special instrumentation for some tests
14 that we wanted to run on Discovery's next flight. They
15 were not mandatory tests, nor is the instrumentation
16 mandatory. They are improvements, nice to have, cut down
17 on the uncertainty of the test results. So, preliminarily,
18 we thought we would use Endeavour's arm and go fly with
19 that arm.

20 Now, given a few more weeks, we are going to take
21 a look at the schedule, and it may be that the repaired arm
22 that came off Discovery and has the special instrumentation

1 may, in fact, go back on Discovery, and that work obviously
2 is being thought about right now -- we have got a lot of
3 folks looking at schedules in various areas -- and how best
4 to make use of our time.

5 MODERATOR: Let's see. Jay Barbree, are you on
6 the line?

7 [No response.]

8 MODERATOR: How about Kelly Young

9 [No response.]

10 MODERATOR: How about Bruce Nichols?

11 QUESTIONER: I'm here, but I have no questions.
12 Thanks.

13 MODERATOR: Thanks, Bruce.

14 Jeff Morris with Aerospace Daily, are you on?

15 [No response.]

16 MODERATOR: How about Mark Kirkman?

17 QUESTIONER: Yeah, I'm on. Can you hear me?

18 MODERATOR: Sure can.

19 QUESTIONER: Yeah. Mark Kirkman with Interspace
20 News.

21 Wayne, some of us were late getting to the phones
22 and have had trouble. Are you going to stick with

1 four-of-four, the criteria with regard to the sensors, and
2 also, what is the status of the two STS issues we discussed
3 a week or so ago of the pre-valve screen and the seals, to
4 maybe go in and take care of those?

5 Thanks.

6 MR. HALE: Thanks.

7 Well, let's see. There are three or four
8 questions there. The pre-valve screen cleaning is still
9 under discussion. That has not come back to the program
10 management for resolution.

11 There were a number of tests being run. You
12 know, all these issues, if you find a problem, you go do
13 some testing or some analysis and come back, and we will
14 either do or not do additional work based on that, and I
15 would say that is a very similar kind of discussion, but we
16 will make that based on the risk versus risk of going into
17 the aft end of the vehicle and opening up that complex set
18 of plumbing that we've got for the main engine system
19 versus the risk of whatever small particle impact might
20 cause us there. So that story hasn't come back to us.

21 The engine seal story is coming together. We
22 have replaced a couple more seals, and we believe we have

1 got good seals in two out of the three engines. They are
2 still looking at, I think, one or two final seals in the
3 first engine that was installed. It is not leaking, but
4 they didn't measure the seals in exactly the right place.
5 So there is some discussion about going ahead and changing
6 those out to make sure that all our seals meet their
7 dimensional requirements.

8 We checked those joints at normal ambient
9 temperature, but those pipes carry cryogenic fluid, and it
10 causes considerable thermal expansion and contraction,
11 really contraction in those areas, and so there is quite a
12 bit an art of doing the analysis to make sure that just
13 because it doesn't leak at room temperature, it won't leak
14 at cryogenic temperature. And I think we are about to wrap
15 that up. There may be one or two more seals left, but if
16 we need to, we will change those out, and if not, we will
17 fly with what we've got because they are not leaking right
18 now.

19 There was another part to your question. I'm not
20 sure I remember what it was.

21 MODERATOR: Four --

22 QUESTIONER: Four --

1 MR. HALE: Oh, the launch commit criteria. You
2 know, we had a long discussion about the requirement for
3 four of four of these sensors.

4 In the early days of the program, in the design
5 phase actually of the program, there was recognized that
6 you really need three sensors. You need two fault
7 tolerance and a critical piece of avionics. So, if two of
8 them were to fail and you still need to function to work,
9 you have to have three. I mean, that is the basic
10 mathematics of redundancy in the Shuttle world.

11 And they also at that time recognized that
12 perhaps the system and not just the sensor, but the whole
13 system, might not have the reliability that they really
14 wanted. So they put four in, thinking you only needed
15 three, and in the early days of the program, we had a
16 launch commit criteria that said three of four sensors was
17 good to fly with. In other words, you could have a failure
18 during the countdown and still proceed to launch.

19 Sometime in the 1986-87 time frame, an analysis
20 was performed that found a commonality in the power, so
21 that you could blow a fuse and lose a particular power
22 circuit in the Space Shuttle orbiter that would take out

1 two of the sensors, and all of a sudden, you no longer have
2 a quad-redundant, but you have a system that really is not
3 as robust as you would like. So they changed the launch
4 commit criteria requirement in those days to four of four,
5 and it has been there ever since.

6 During the down time after Columbia, we approved
7 the wiring change to go back and rectify that, so we no
8 longer have a common power circuit that single failure can
9 take out two sensors, and ever since then, we have been in
10 discussions about "Is three of four okay to go back to?"

11 For STS-114, Discovery's last flight, we agreed
12 to a three-of-four criteria in a very limited set of cases,
13 only the hydrogen sensors, only one of the sensors that we
14 had previously felt we had problems with, and only if it
15 failed in the wet reading direction.

16 The discussion today with the new engineering
17 data, we think that the sensors might actually have the
18 potential to fail in the dry sensor reading. That puts a
19 whole new framework to the discussion.

20 We don't think we are quite as tolerant to dry
21 failures as we are to wet failures. So we have instituted
22 that launch commit criteria change on the last flight only

1 for that flight in only for a very specific small set of
2 cases.

3 We never instituted a generic, any three out of
4 four, any way, go fly. We don't have any change to the
5 four-of-four launch commit criteria currently in place for
6 the next flight. Based on what we are learning, we are
7 going to go off and talk about that again, so we understand
8 where we should be on launch day, but as of right now, it
9 is still four of four.

10 That is a long answer to kind of a short
11 question. I'm sorry.

12 MODERATOR: Let's see. Jeff Morris, did I
13 already call? How about Justin Ray?

14 [No response.]

15 MODERATOR: USA Today?

16 [No response.]

17 MODERATOR: How about Nancy Holland?

18 [No response.]

19 MODERATOR: How about Allen Boyle with MSNBC?

20 QUESTIONER: Here I am. Can you hear me?

21 MODERATOR: Yes, sir.

22 QUESTIONER: Wayne, I wanted to double check on a

1 couple of questions, if you don't mind. One would be the
2 procedure, just to recap the procedure for changing out the
3 sensors. Do you have to take the tank to a horizontal
4 position inside the VAB?

5 And then the other, you made a reference to this
6 mission and the next mission. Now, if both of those
7 missions might be test missions, does that mean that the
8 construction mission goal will be changed or delayed?

9 MR. HALE: Well, okay. Let's start first with
10 the question. The actual change-out of the sensors will be
11 done while the tank is in the vertical, hanging up in the
12 vehicle assembly building as it is now in what we call the
13 check-out cell. However, in putting the foam back on the
14 bottom of the tank, it is preferred that that is in a
15 horizontal position.

16 So, after we get done with the inside of the tank
17 and have the new cover bolted back on, they will actually
18 pick the tank up and put it on the transporter in the
19 transfer aisle in the middle of the VAB and apply the foam,
20 and at that point when they are done with the foam work,
21 the insulation work, they will pick the tank up from the
22 transporter and take it right over to the integration cell

1 which is where the solid rocket boosters are waiting for
2 the tank to arrive, and after that, of course, the orbiter
3 comes.

4 Okay. I am having trouble remembering two
5 questions.

6 MODERATOR: The second is the mission after this
7 upcoming one.

8 MR. HALE: Yes. It's not a test mission, per se.

9 In fact, STS-115, which will fly later in the fall, will
10 be a construction mission, but we are going to carry the
11 next solar array up to the International Space Station as
12 the current manifested cargo.

13 But what I did say is we do want to have a
14 daylight launch to, one more time, look at particularly the
15 performance of the tank, really the entire vehicle, but
16 particularly the performance of the tank in the daylight to
17 make sure we have two good launches with no significant --
18 and we are going to have some small foam losses, but no
19 significant foam losses that we should worry about. So we
20 would really like to get to daylight opportunities.

21 I am sure we will have a discussion based on what
22 we see after 121. We have got some new cameras. There are

1 a large number of folks that believe that it is possible we
2 could launch after dark because the brilliant light that is
3 generated by the solid rocket boosters should illuminate
4 the tank from below, and these new cameras are at a lower
5 position looking up. That remains to be seen.

6 Right now, we have said we would like to have
7 daylight for both STS-121, the next flight, and the flight
8 following that, STS-115. It is not in any other respect, I
9 think, a test mission. STS-115 will be an assembly flight.

10 MODERATOR: Let's see. Pat Duggins with NPR, are
11 you on?

12 [No response.]

13 MODERATOR: I hear somebody breathing. Who is
14 breathing, since I don't have you on the list? I don't
15 have a breather.

16 [Laughter.]

17 MODERATOR: Let's see. Chris Dolmetsch, are you
18 on, with Bloomberg?

19 QUESTIONER: I am, indeed. Can you hear me?

20 MODERATOR: Yes, sir.

21 QUESTIONER: Okay. I guess, you know, my only
22 question, this may have addressed earlier, Wayne, but I was

1 just wondering do you think with the schedule you have that
2 the Administrator had thought it was possible to get in
3 three flights this year, or do you think that is possible
4 at all?

5 MR. HALE: Well, I do think it is possible. We
6 need to go work on the schedule a little bit and see how
7 quickly we can get the vehicles turned around, but I
8 definitely would not take that off the table at this point.
9 I still think it is entirely possible we could get there
10 Shuttle flights in this calendar year.

11 MODERATOR: Let's see. Jim Oberg, are you on?

12 [No response.]

13 MODERATOR: Okay. I'm running out of people
14 here. Let's see. Fannie Carter with AFP, are you on?

15 [No response.]

16 MODERATOR: Okay. Is there somebody on that I
17 called on or have not called on?

18 QUESTIONER: Can you hear me? I'm Nell Boyce
19 [ph].

20 MODERATOR: Yes, ma'am. Go ahead.

21 QUESTIONER: Yeah. Hi. Thanks.

22 Could you describe a little more the different

1 type of failure you all now feel that the sensor could
2 cause? You talked about errors in the wet versus dry
3 situations, but I am not entirely clear on what this means
4 in terms of a different type of danger that it could cause
5 the Shuttle in case of malfunction.

6 MR. HALE: Well, let's see. There's a couple of
7 ways I could take that question.

8 The way these sensors work, it is a ceramic
9 square, hollow square, that has a platinum sensor wires
10 zigzagged across it. I think we showed a lot of pictures
11 last year. I'm sorry I didn't bring a show-and-tell with
12 me today. We can certainly dig some of those out.

13 The platinum wire, the very thin hair-like
14 platinum wire is very sensitive to temperature changes. It
15 changes the resistance in that wire.

16 When the wire is dumped in a cryogenic fluid,
17 liquid hydrogen or liquid oxygen, the resistance in the
18 wire gets very low.

19 When the fluid no longer covers that wire and the
20 temperature starts going up, the resistance starts going
21 up. So there is an electronics box that looks at
22 resistance and interprets whether or not the sensor is dry

1 or wet.

2 There were very clever when they designed this
3 box sometime ago -- and I think the circuit design actually
4 is an Apollo-Saturn-Heritage circuit design -- that says,
5 however, if we know it is an open circuit, if there is
6 extremely high resistance, it is not just dry, it is an
7 open circuit, we are going to declare that sensor wet
8 because wet failures are more benign.

9 In other words, we are not likely, as I described
10 to you earlier, to run out of gas. We have put in extra
11 propellant. We have designed our flight, so that we have
12 more hydrogen and oxygen in the tank than we really need to
13 achieve orbit, and so we are unlikely to get to the point
14 that you need to cut off the engine. So, if a sensor is
15 going to fail, if it fails to the wet state, that is
16 probably benign.

17 If you had multiple sensors fail to the wet
18 state, of course, you would lose the protection that you
19 would like to have because they vote for shutdown.

20 If they fail to the dry state, that is an
21 indicator to the on-board computer software that we ought
22 to shut the engines down.

1 So there is less a requirement, I guess you'd say
2 it, in that you could be flying along perfectly fine, and
3 if a number of these sensors failed to the dry state, it
4 would shut the engines off early, prematurely, which is not
5 a good thing in space flight.

6 So, from the potential to cause problems,
7 obviously you want to shut the engines down if you are
8 running out of gas, but you don't want to shut the engines
9 down early if you are not running out of gas. It's kind of
10 either way, you can get in trouble.

11 It is more benign to have a wet failure than a
12 dry failure when you do the logic analysis, but neither
13 failure is really what you want. We would like to have
14 four really good sensors, wires that connect the sensors,
15 back to the orbiter, connectors all the way down those
16 wires, a point-sensor box that interprets that.

17 We would like to have a good system when we go
18 fly, and when you get right down to it, that is why we are
19 going to change these sensors out, as to have the very best
20 shot at having a very good system -- can't say perfect
21 because nothing is ever perfect, but as close to perfect as
22 we can get before we go fly because this is what we call

1 "Criticality One," life-or-death kind of situation that you
2 want those sensors to work properly, either way.

3 They can prevent bad things from happening if
4 they work properly, and certainly, if they work badly, they
5 can cause bad things to happen. So we need to have a good
6 set.

7 MODERATOR: Okay. I have time for one more. Is
8 Dave Waters on the line from Channel 13 down in Florida?

9 [No response.]

10 MODERATOR: Okay. One last chance. Is there
11 somebody that I called on that wasn't on or that I didn't
12 call on?

13 [No response.]

14 MODERATOR: Okay. It sounds like we got
15 everybody in that we needed to. It's all the time we have.
16 So I appreciate everybody coming and participating. Have
17 a nice evening. Thanks.

18 [End of Space Shuttle Program Status Briefing.]

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